THE OCCURRENCE OF NON-PARASITIC MITES, *Scheloribates* sp. (ACARI: ORIBATIDA) ON ANURANS FROM URBAN AREAS IN SARAWAK

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Received: 13 October 2022; Acceptance: 27 June 2023

ABSTRACT

A survey of ectoparasitic infestation on anurans in urban areas of Kota Samarahan, Sarawak, Malaysian Borneo has been conducted from September 2019 until January 2020. This study aimed to determine the species prevalence and composition of ectoparasites on anuran in the urban area of Kota Samarahan. The host collection was done by using the method of Visual Encounter Survey (VES) and the hand-netting method. A total of 120 individuals comprising six anuran species namely, *Chalcorana raniceps*, *Duttaphrynus melanostictus*, *Fejervarya limnocharis*, *Hoplobatrachus rugulosus*, *Kaloula pulchra* and *Polypedates leucomystax* were captured and screened for ectoparasites. One species of non-parasitic Oribatida mites, *Scheloribates* species was found infested by four individuals (3.3%) of *D. melanostictus*. This preliminary survey produced the first record of non-parasitic mites found on anurans in the urban area of Kota Samarahan and further research needs to be done since the status of *Scheloribates* sp. is still unknown as the parasitic of anurans, and the finding can become a pioneer for future research.

Keywords: Anuran, species prevalence, urban area, ectoparasites, Kota Samarahan, Malaysian Borneo

ABSTRAK

Tinjauan mengenai infestasi ektoparasit ke atas anuran di kawasan bandar Kota Samarahan, Sarawak, Borneo Malaysia telah dijalankan dari September 2019 hingga Januari 2020. Kajian ini bertujuan untuk mengetahui kelaziman spesies dan komposisi ektoparasit pada anuran di kawasan bandar Kota Samarahan. Pengumpulan perumah telah dilakukan dengan menggunakan kaedah Visual Encounter Survey (VES) dan kaedah jaringan tangan. Sebanyak 120 individu yang terdiri daripada enam spesies anuran iaitu, *Chalcorana ranices*, *Duttaphrynus melanostictus*, *Fejervarya limnocharis*, *Hoplobatrachus rugulosus*, *Kaloula pulchra* dan *Polypedates leucomystax* telah ditangkap dan disaring untuk pengesanan kehadiran ektoparasit. Satu spesies hama Oribatida, bukan parasit, spesies *Scheloribates* didapati telah

menjangkiti empat individu (3.3%) perumah *D. melanostictus*. Tinjauan awal ini merupakan rekod pertama, hama bukan parasit yang ditemui pada anuran di kawasan bandar Kota Samarahan. dan kajian lanjut perlu dilakukan bagi mengetahui status *Scheloribates* sp. yang masih tidak diketahui sebagai parasit pada anuran di kawasan urban ini dan penemuan ini boleh menjadi perintis untuk penyelidikan masa depan.

Kata kunci: Anuran, kelaziman spesies, kawasan bandar, ektoparasit, Kota Samarahan, Borneo Malaysia

INTRODUCTION

A parasite that resides on or inside the skin is considered as ectoparasite. Ectoparasitosis is an ectoparasite infestation and the host infested with ectoparasites is not affected as severely as the other endoparasite-infected hosts (Diaz 2015). Nevertheless, some of these ectoparasites are the vectors of pathogens. Many ectoparasites that are related with domestic animals have been acquired through the introduction of either host or parasite into the new areas, as those animals have been domesticated worldwide (Hopla 1994). Parasites also colonize new geographical areas by infested the host species (Drake 2014). Some of the colonizer parasites may infect and colonize indigenous host species or endemic species in an area. In addition, some native parasites may infect the colonizer which may increase native populations' transmission and abundance (Barton 1996; Kennedy 1996).

Anuran is an order categorized under the Amphibian class and consisted of frogs and toads that had no tail when they were an adult (Inger & Stuebing 2005). Amphibians are among the most endangered classes and threatened with 41% species extinction rate worldwide (IUCN 2022). A total of 7,486 species of amphibians have been recorded in IUCN checklist and among these 36 species are already extinct, 722 species listed as critically endangered, 1,144 species are endangered and 740 species are vulnerable (IUCN 2022). Anurans also known as excellent biological indicators especially for the environmental assessment where they play important linkage between human and the ecosystem health as they live both in aquatic and terrestrial ecosystem (Simon et al. 2011). The declines of anurans populations in the ecosystem can become a clue caused by several factors including pollution, climate change, habitat loss and fragmentation, chemical pollution, and ultraviolet radiation, as well as disease outbreaks (Simon et al. 2011).

Urbanization is a global trend that threatens biodiversity at various environmental stages (Blair 2004; Marzluff et al. 2001). Urbanization has been stated as an important factor that cause the declines of amphibian globally and even though recent work has elucidated the significant influence of wide-ranging ecological patterns of amphibian populations, information about the factors that affect the structure of the amphibian communities in urban landscapes is still insufficient (Pillsbury & Miller 2008). The native parasites can infect but not transmit the introduced host, and thus the introduced host acts as a "sink" to minimize the risk of infection to native hosts (Poulin et al. 2011). In recent decades, the effect of urbanization on infectious diseases has been a concern (Gratz 1999; Schrag & Wiener 1995).

A study on the ectoparasites conducted by Madinah et al. (2021) from different habitats of Sarawak have been conducted on rodents and scandents, but not include the another taxa groups of animal such as Anurans. Therefore, due to the knowledge gap on anurans ectoparasite fauna infestation especially in Malaysian Borneo, a survey of ectoparasites on anurans from

urban areas was conducted to determine the species prevalence and the composition of ectoparasite fauna on anuran in urban area of Kota Samarahan, Sarawak, Malaysian Borneo

MATERIAL AND METHODS

This study was conducted at 12 different sites within the urban areas of Kota Samarahan, Sarawak, Malaysian Borneo which are Kampus Timur UNIMAS (1.4705° N, 110.4355° E), Kompleks Sukan UNIMAS (1.4614° N, 110.4366° E), Desa Ilmu (1.4529° N, 110.4575° E), Uni Garden (1.4618° N, 110.4575° E), Samarahan jetty (1.4729° N, 110.4298° E), Taman Samarindah (1.4470° N, 110.4119° E), Uni Square (1.4637° N, 110.4179° E), Place 2 Stay Hotel (1.4887° N, 110.4050° E), Taman Hill View (1.4082° N, 110.3653° E), Muara Tuang (1.4595° N, 110.4906° E), Asajaya (1.5461° N, 110.5191° E), and Aiman Mall (1.4554° N, 110.4464° E) (Figure 1). The surveys and hosts collection were conducted during night from 1900 to 2200 hours where most of the anuran came out actives during that period.

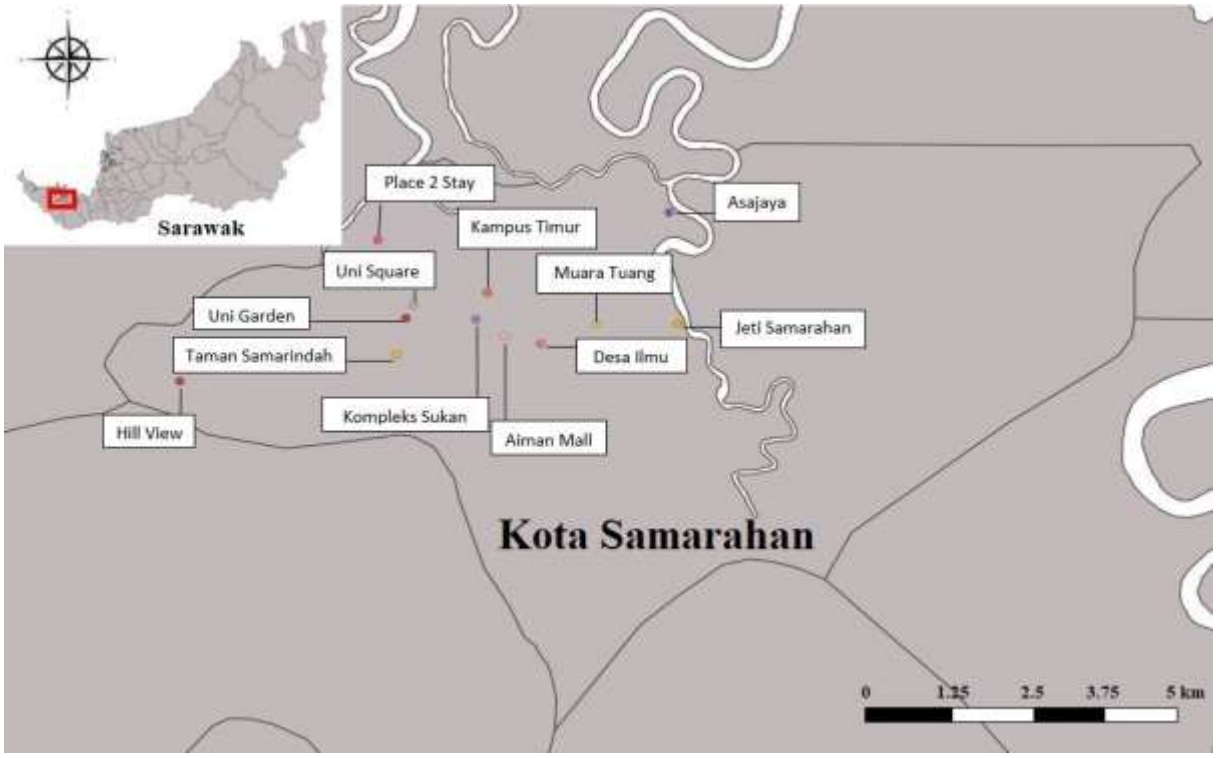

Figure 1. Map of Sarawak and the location of the study areas within the Kota Samarahan, Sarawak

The sampling was conducted during the night using the Visual Encounter Survey (VES) method, manual hand-picking and hand-netting methods. The collected anurans were kept in the separated air-ventilated plastic bags to avoid the cross-contamination of parasites between the anuran individuals, thus preventing the human-error of parasites infestation assessment record. Each separated plastic bags were labelled properly including the time, and location of host being collected. The collected anurans were then brought to the laboratory for further processes.

All anurans collected were identified according to Inger et al. (2017) and Inger and Stuebing (2005). Each anuran host was being euthanized with excess diethyl ether in the

euthanizing container. It was then weighted using Pesola spring scale and the entire body of the host was examined using stereo microscope (7X - 45X magnification) to detect the presence of ectoparasites infestation. Any arthropod ectoparasites such as mites and ticks were collected by using scalpel, forceps and were preserved in the vial filled with 70% ethanol solution for long-term preservation.

Preserved ectoparasites were sorted based on their morphology characteristic and was preliminary identified under the dissecting microscope. The mounted slides were prepared and technique for mounting of ectoparasites followed the methods of Madinah et al. (2011; 2013) for acarines ectoparasites except for ticks. The pictures of the ectoparasites were captured directly from the microscope and were identified up to the species level where possible using available keys, published taxonomic drawings and references (Baker et al. 1962; Domrow 1962; Ermilov & Anichkin 2014; Ermilov & Stary 2017; Nadchatram & Dohany 1974). The prevalence of the ectoparasites was determined by using the percentage prevalence formula which is Prevalence = (Total no. of infested hosts / Total no. of host individual) x 100%.

RESULTS

A total of 120 individuals of urban anuran belongs to five families and six species namely, *Duttaphrynus melanostictus* (Bufonidae), *Fejervarya limnocharis* and *Hoplobatrachus rugulosus* (Dicroglossidae), *Kaloula pulchra* (Microhylidae), *Chalcorana raniceps* (Ranidae), and *Polypedates leucomystax* (Rhacophoridae) were collected and examined for ectoparasites infestations. The most anurans species caught in urban area of Kota Samarahan were Asian toad (*D. melanostictus)* with a total of 65 individuals while common tree frog (*P. leucomystax*) was represented by only one individual. Among all the anurans examined, 3.3% were found to be infested with ectoparasites (Table 1).

Table 1. Prevalence of ectoparasites infestation on anurans species at urban area of Kota Samarahan, Sarawak

Host species	**No. of host caught**	**No. of hosts infested**	**No. of ectoparasites found**	**Prevalence (%)**
Toad				
Bufonidae				
Duttaphrynus melanostictus	65	4	4	3.33
Frog				
Dicroglossidae				
Fejervarya limnocharis	24	0	0	0
Hoplobatrachus rugulosus	3	0	0	0
Microhylidae				
Kaloula pulchra	7	0	0	0
Ranidae				
Chalcorana raniceps	20	0	0	0
Rhacophoridae				
Polypedates leucomystax	1	0	0	0
Total	120	4	4	

Among the anurans examined, only one groups of ectoparasites which belongs to mites was discovered in this study. One species of ectoparasite was identified namely, *Scheloribates* sp. which is known as non-parasitic mites (Figure 2). This non-parasitic mite was found

attached on the body of four individuals of anuran, *D. melanostictus* with a total of four individuals (Table 1). Meanwhile, the other anuran species were not found to be infested by neither the parasitic nor the non-parasitic microarthropods.

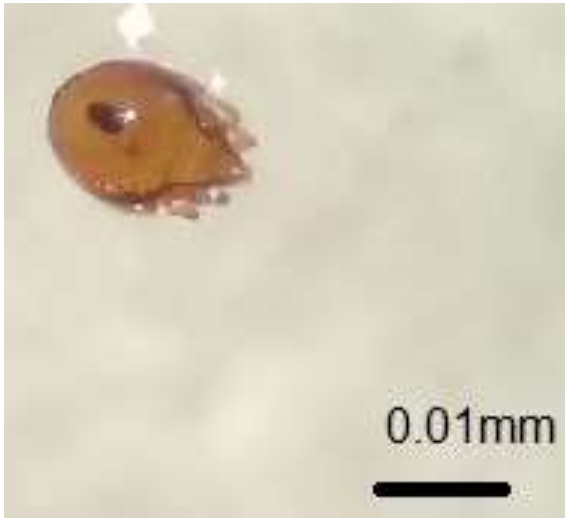

Figure 2. *Scheloribates* sp. infested anuran host, *Duttaphrynus melanostictus* in the urban area of Kota Samarahan, Sarawak

DISCUSSION

Throughout the sampling period, six species of anurans have been collected in urban area of Kota Samarahan, Malaysian Borneo. The composition of anuran species in the urban region altered due to urbanization, which may have decreased the abundance and richness of the species composition as a result of environmental changes caused by anthropogenic activities such as vegetation removal (Oda et al. 2017; Pillsbury & Miller 2008). On the other hand, the anuran diversity in rural sites was higher than in urban area (Menin et al. 2019), thus this is congruent with current study in the urban area of Kota Samarahan. This might be possibly due to the lack of anthropogenic activities done in the rural areas compared to urban areas. In addition, habitat utilization by the host, differences in physiology and morphology, behavioral characteristics of the host and health of the host due to environmental changes such as pollution can contribute to differences in the composition of anuran in an area (Díaz-Páez et al. 2016).

From four individuals of anurans examined, only one species of mites namely, *Scheloribates* sp. was found on the skin of anuran, *Duttaphrynus melanostictus*. This mite was categorized under the order Oribatida. Unfortunately, none of the Oribatida mites are known as parasitic and their feeding habits could be different between the immature and adults of the same species (Walter & Proctor 2013). The *Scheloribates* species previously found to become the most prevalent Oribatida mites in a meadow soil (Baur et al. 1996; Cernova & Cugunova 1967). Oribatid mites showed lower results in abundance and diversity at a very poor habitat where the soil contains low organic matter contents and high concentration of anthropogenic inputs such as construction wastes (Vacht et al. 2019). However, the Oribatida communities become richer in species composition in older soils where it is influenced positively by the vegetation presence (Madej et al. 2011; Wissuwa et al. 2012). The order Oribatida is a group of fauna that delivered an economic importance by increasing the organic materials breakdown in the soil, in a same way as the earthworms (Baker & Wharton 1952). This species might be possible to be found on the skin of the anurans nevertheless its status of ectoparasites need to

be further studied since these mites was the only non-parasitic microarthropods that was found on the captured anuran in this study instead of other ectoparasitic organisms that theoretically should be.

Besides, most of the collected anurans in this study were found at the grass field or meadow at the urban area of Kota Samarahan. Therefore, the Oribatida mites were likely to presence on the anurans that were found on the organic soils rather than at the urban settings such as concrete, drains and the road. However, this study found that the occurrence of this mite species only recorded attached on the skin of the toad (*D. melanostictus*) instead of the frogs most probably because toads have rough, dry skin and warts and this makes it easier for mites and other microarthropods to be on their bodies compared to frogs that have moist, smooth and slimy skin. Therefore, based on this situation, not a single frog was recorded to be infested by any arthropod-like ectoparasites in this study.

The frog skin is covered in a layer of mucus which helps the skin to retain moisture for respiration and stay hydrated (Chaffin 2014). The presence of microarthropods were not found on the skins of the frogs because of their smooth and slimy skins which ease the microarthropods to slip away or detached from the host skins when the host make a physical movement. Meanwhile, it is more likely for the presence of microarthropods such as Oribatida mites to be found on the toad skin such as *D. melanostictus* because of its warty and rough skin that could protect the mites or any microarthropods to attach on it. This situation has been proved in a study by Prawasti et al. (2013) who reported the infestation of three mite's species (Acari: Pterygosomatidae) on Gecko due to the number of skin folds of the host as it provides an important site for the protection of the mites. Therefore, the skin morphology of the host is one of the aspects that manipulate the prevalence of the microarthropods on the host.

Habitat utilization and ecological niches of the anurans that were collected in this study also became the other element that influence the prevalence of *Scheloribates* sp. on the hosts. Frogs mostly spend their times on the land and they usually return to the water only for breeding purposes. Therefore, they need a water bodies such as a pond with a gentle slope that is covered with vegetation on the sides. The frog loss a considerable amount of water by evaporation during activities on the night and regains back the water by absorption from the water bodies such as pond or river on their daytime retreats (Van Berkum et al. 1982). Due to their all-the-time-moist behaviour, the probability for the *Scheloribates* species or any microarthropods to attach on the frog's skins is low as the frogs constantly rehydrated themselves in the ponds or any water bodies by absorbing it through their skins.

According to Cumming and Van Buuren (2006), other ectoparasites such as ticks are strongly conditioned to be vulnerable to desiccation and take longer in cold environments to achieve maturity. Tick colonies can grow quickly during favourable times and ticks are able to withstand lengthy stretches of unfavourable conditions by diapausing or seeking locally preferred microclimates. Based on Sulkava and Huhta (2003), lower temperature will significantly reduce the number of ectoparasitic microarthropods and the food resources were favourably changed. The temperatures recorded in this study is slightly colder during night time than during the day with a high percentage of humidity which could affect the Oribatid mites and other ectoparasitic organism communities that can be found and infesting on the anuran in urban areas of Kota Samarahan, Sarawak.

This study contributes to the growing literature on ectoparasite on anurans especially in Borneo Island. The preliminary survey and finding of this study provided the initial information

on what possible of ectoparasite composition species in urban area on anurans which largely lacking in this region. This finding also provides some preliminary insights on epidemiological parasite infection from anurans in Kota Samarahan, Sarawak that will be critical for future control of parasite disease mortality or other zoonotic outbreak in the area.

CONCLUSION

The prevalence of ectoparasitic infestation on anurans from urban area in Kota Samarahan, Sarawak, Malaysian Borneo was very low with the prevalence of 3.33% which infested four individuals of Asian toad, *D. melanostictus*. Meanwhile, no ectoparasites infestation was recorded for other species of anurans from urban areas in Kota Samarahan, Sarawak which probably due to several factors such as host skin, habitat utilizations and climatic influence. Moreover, this study indicated that grass fields or meadow area within Kota Samarahan bears some non-parasitic microarthropods such as *Scheloribates* sp. and more species are thought to be found. Study sites which were designated at the urban settings such as housing area, drainage system, jetty and market areas might have ectoparasites that probably can be found infesting the anuran. Apart from that, this finding could be the baseline data for the concern of anuran composition in urban areas of Kota Samarahan. Moreover, this is only a preliminary study and further investigation about the ectoparasitic status of the *Scheloribates* species needs to be done since the species was also found on the urban anuran and not only from the soil. Besides, the combination of molecular tools and morphological identification needs to be used in order to reconfirm the identification until species level. Further surveys need to be carried out for a longer survey period in order to build up an extensive wealth of information on various aspects such as anurans-parasite relationship, biology and their ecology.

ACKNOWLEDGEMENTS

The authors wish to thank the Universiti Malaysia Sarawak (UNIMAS) for permission to conduct research and to publish the data. We are also grateful to the Secretary of Kota Samarahan City Council for granting us permission to conduct the surveys of anurans in Kota Samarahan. We also acknowledge the assistance rendered by the colleagues from ParaForento Laboratory for the continuous support and motivation during the laboratory work and while writing this manuscript and also the residents of Kota Samarahan, who were directly or indirectly involved in this study. This study was financially supported by Fundamental Research Grant Scheme for Research Acculturation of Early Career Researchers (RACER/1/2019/SKK12/UNIMAS//l) awarded by Ministry of Higher Education Malaysia.

AUTHORS DECLARATIONS

Funding Statement

This study was financially supported by Fundamental Research Grant Scheme for Research Acculturation of Early Career Researchers (RACER/1/2019/SKK12/UNIMAS//l) awarded by Ministry of Higher Education Malaysia.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethics Declarations

All procedures in this study have been permitted and approved by the Universiti Malaysia Sarawak Animal Ethic Committee along with permit number UNIMAS/AEC/R/F07/046.

Data Availability Statement
Data that support the findings of this study are openly available in this article.

Authors' Contributions
Data curation, investigation, visualisation and writing-original draft: ASAS. Data curation, investigation, and resources: ZHA, and AHAI. Conceptualisation, funding acquisition, project administration, supervision, validation, and writing-review and editing: MA.

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